APPENDIX D:
EXAMPLE CONCEPTUAL SITE MODEL

Example Conceptual Site Model

1. *General Background.*

The Charles E. Kelly Support Facility (CEKSF) is an active U. S. Army facility located near Oakdale, in Collier Township, Pennsylvania. CEKSF was first occupied in 1958 by the U.S. Army Air Defense Command (ARADCOM) Headquarters, Headquarters Battery and 18th Artillery Group, and the 662nd Radar Squadron of the U. S. Airforce (USAF) (USATHAMA 1993). ARADCOM Headquarters at Oakdale supported 12 Nike sites in the Pittsburgh area, as well as other Nike sites in defense of Cincinnati, Cleveland, Detroit, and Buffalo. Both Nike Ajax and Hercules systems were used. Headquarters U. S. Army Support Detachment, Oakdale, Pennsylvania moved to the Oakdale post in 1961. The Federal Aviation Administration (FAA) assumed part of the radar mission from USAF in 1962, and in 1972, it assumed the complete radar mission. As a result of developments in the air defense system, many of the Nike sites were deactivated and excessed. Ten of the 12 Pittsburgh area Nike sites were excessed between 1962 to 1974. Subsequently the ARADCOM operation at Oakdale was deactivated in June 1975, leaving U.S. Army Support Detachment and FAA as the main activities at Oakdale.

The CEKSF facility currently consists of numerous separate areas: the main post, former Nike Missile Site 63, the Readiness Group (also known as the former Nike Missile Site 62), the GATR SAGE (Ground to Air Transmission Radar, Surface Air Guidance Equipment) site, and remote facilities at Neville Island, former Nike Missile Site 36 in Irwin, PA, and facilities at Camp Dawson, West Virginia (*1998 Installation Action Plan*). Its current mission is to provide administrative and logistical support to tenant and satellite units and activities and organizations, departments, or agencies of the government as prescribed in appropriate regulations, directives, or agreements[1]. Its primary tenants include:

- 99th Regional Support Command;
- 5th Training Battalion;
- Federal Aviation Administration (FAA);
- GSA Fleet Management;
- Defense Commissary Agency; and
- Army/Air Force Exchange System (AAFES).

Building S-15 (DSERTS Site #8) is located on a hill within CEKSF's main post near Oakdale, PA. Building S-15 is located in Allegheny County, Pennsylvania approximately 10 miles southwest of Pittsburgh. Historically, Building S-15 was the primary generator building of the NIKE Missile Master Control Facility. After the site was

[1] U.S. Army. Charles E. Kelly Support Facility Webpage. Available URL: http://www.dix.army.mil/cekelly/hq.htm. Retrieved 22 September 1999.

deactivated in 1974, the Army Maintenance Support Activity (AMSA) used the property for military vehicle storage and later (from 1985 to 1990) for vehicle maintenance. The 420th U.S. Army Reserve then used the property for vehicle and equipment storage and maintenance until April 1995. Since 1995, the 99th Army Reserve Command (ARCOM) Logistics Unit has used the site for vehicle storage and maintenance.

A 650-gallon used-oil underground storage tank, located on the southwest side of Building S-15 was installed in 1985 and removed 9 years later on April 4, 1994. No obvious holes were observed in the tank but some of the soils in contact with the tank were stained black (Engineering Science [ES] 1994a). Samples taken at the bottom of the excavation and in the stockpiled soil revealed lead and TPH_d contamination (ES 1994a). The excavation was lined with Visqueen™ and the contaminated stockpiled soils returned to the excavation until a site assessment could be completed and a corrective action plan prepared. In May 1994, Engineering Science conducted a Site Assessment to investigate the extent and magnitude of the residual petroleum hydrocarbons. They installed 11 soil borings, ten of which were completed as monitoring wells. Samples were analyzed for only TPH, lead, and BTEX compounds, and identified contamination in both the soil and groundwater (ES 1994b). Engineering Science then completed a Remedial Action Plan in January 1995 that called for extended excavation of the site and offsite disposal of the contaminated soil (ES 1995). Efforts were initiated to complete these activities through the Army Corps of Engineers (ACE).

In December 1995, Parson's Engineering Science collected soil and groundwater samples for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) analyses for comparison to the preliminary remediation goals (PRGs) included in the Relative Risk Site Evaluation (RRSE) Primer. These data were needed for input into the DSERTS database and to aid prioritization and funding of further environmental restoration activities at this site. Unfortunately, the analytical detection limits were inadequately sensitive to determine if these samples exceeded the PRGs, and thus provided little value in reducing the number of potential contaminants of concern. These data did confirm the presence of SVOCs (e.g. naphthalene) and BETX, and suggested the presence of solvent contamination (e.g. 1,1-Dichloroethane)[2]. These results lead to changes in the scope of work being negotiated between CEKSF, ACE, and the ACE subcontractor (GZA GeoEnvironmental, Inc. [GZA]) from a focus on TPH contamination to include VOC contamination.

In July 1997, GZA performed a groundwater quality study to gather current groundwater data concerning the presence of VOCs and naphthalene (GZA 1998a). PNNL recommended changing analytical methodologies to be able to identify compounds indicative of natural degradation and/or to help define the source(s) of contamination (i.e., fingerprinting). PNNL performed these analyses on spilt samples jointly collected with GZA (Liikala 1998). In addition, GZA sampled and drummed up a small soil pile overlying the site. This study confirmed the presence of BETX and chlorinated solvent

[2] Parsons Engineering Science, Inc. (PES). 1996. Letter to Mark Bishop, Armstrong Laboratory, dated 23 February 1996, from Gary Wm. Gray.

compounds, with benzene, TCE, 1,1-DCA, and naphthalene exceeding the PADEP's statewide health standards for residential groundwater, and that the contamination originated on-site.

In September 1997, PNNL performed a soil gas survey to determine the source and extent of VOC contamination (Liikala 1998). Results suggested that the BETX and TCE contamination emanated from the general vicinity of the former used oil tank, and defined the lateral extent of this contamination. In addition, the study found that fluctuating water levels, perched water conditions, poor flush to ground well completions, improperly backfilled direct push boreholes, numerous underground utilities, and stormwater drain systems were allowing surface contamination to fast-track into the subsurface, thereby impacting the site. Interim remedial actions were subsequently taken to 1) redesign and seal the well heads and boreholes (Schalla and Newcomer 1998), 2) to cap the site of the former UST and 3) to redirect stormwater away from the UST site.

At the 1997 Installation Action Plan meeting, (CEKSF 1998) PADEP requested that additional efforts be made to define the site's vertical extent of groundwater contamination, and recommended sampling of groundwater seeps and installation of a deeper groundwater well(s). CEKSF and AEC agreed on this additional scope and PNNL prepared sampling and analysis plans for both these activities and completed an initial cataloging of adjacent landowners. PNNL also prepared a preliminary site conceptual model and risk analysis to evaluate transport pathways and risks posed by this contamination and to help determine if additional data were indeed necessary (Bjornstad et al., 1998). However, the perched water and partially saturated fractured rock environment makes interpretation of the potential transport pathways extremely difficult.

In the Fall of 1998, a round of groundwater samples was collected to evaluate the effectiveness of the interim remedial actions taken to revamp the well vaults and to stop localized recharge over the site. However, these samples continued to reveal that several contaminants (benzene, TCE, vinyl chloride, PCE, 1,1-DCA, naphthalene, and bis(2-ethylhexyl)phthalate, lead, and manganese) remain above the statewide health standard[3].

In July 1999, PNNL was authorized to prepare a Site Characterization Report in accordance with PADEP's Corrective Action Process and Land Recycling Act. The objective of this report was to document all available data and current interpretations, and to seek a determination that no further action would be necessary at this site. At the July 1999 Installation Action Plan meeting, USARC agreed with PADEP's recommendation to sample groundwater seeps around the S-15 site, and to install a deep well to define the vertical extent of the groundwater contamination. Proposed changes to the workplan have been prepared to incorporate this new work.

[3] "Recent Groundwater Data from S-15". Letter from George V. Last to Sonja Scancar, dated January 27, 1999.

2. Regulatory Drivers/Identification of Problem.

Environmental restoration of the Building S-15 site is being conducted under the U.S. Army's Installation Restoration Program (IRP) and in accordance with the Multi-Site Agreement (MSA) and Pennsylvania's Land Recycling Act (Act 2). Environmental contamination at the site was found, at least in part, during the removal and assessment of an Underground Storage Tank. Thus, completion of the environmental restoration of the site is being conducted in accordance with the Corrective Action Process (CAP) of Pennsylvania's Storage Tank Program (Act 32, as amended) and the Act 2 cleanup standards[4]. Act 2 basically has three types of cleanup standards: background, statewide-health, and site-specific. The presence of anthropogenic contaminants (e.g. benzene, trichloroethene, 1,1-DCA) in wells clearly indicates that contamination originated on site and that use of the background standards would not be appropriate. Concentrations of benzene, TCE, vinyl chloride, PCE, 1,1-DCA, naphthalene, bis(2-ethylhexyl)phthalate, lead, and manganese in some groundwater samples exceed statewide-health standards for residential use of groundwater. However, lead and manganese are believed to be natural background and ultimately not of concern. To date, virtually no efforts have been directed at developing site-specific cleanup standards for the site. To do so requires a very detailed process, both technically and administratively, in which the human and ecological receptors need to be addressed either through elimination of exposure pathways or a risk assessment, and also provides an opportunity for public participation.

Thus, to date all contaminant concentrations have been compared to the Statewide Health standards. Based on these standards, the primary concern at the site is the presence of benzene, trichloroethene, 1,1-dichloroethane, and naphthalene. Benzene has been detected in 4 monitoring wells at levels between 1 and 3 times the 5 µg/L standard. Trichloroethene has been detected in a single well at a level greater than 4 times the 5 µg/L standard. 1,1-dichloroethane has been detected in 3 wells at levels above regulatory standards (up to 3 times the standard). Naphthalene has been detected in 3 wells at levels over 2 to 4 times the 20 µg/L standard. The wells are completed in a perched aquifer that does not extend off site. However the extent of contamination with depth has not been determined.

No on-site wells are believed to use water from this site. Engineering Science (ES 1994a) did not find a potable water well within one-half mile radius of the site. However, the Pennsylvania Geologic Survey's data base of groundwater wells, searched by ES, is far from complete, mainly because there is no requirement to register groundwater wells within the state.

No offsite private wells have been located in the vicinity of Building S-15. Although most residences are believed to be supplied by a private water utility, there is no guarantee that groundwater is not and will not be used for either drinking water or for

[4] "Project Scoping Meeting for FY99..." 18 December 1998. Meeting Minutes. From George V. Last to Attendees and Distribution.

irrigation/livestock. There is no requirement to register groundwater wells within the state. Thus, the State's position is that the only applicable statewide health standards are those for "used aquifers".

The CE Kelly Support Facility does handle and store hazardous waste, however it qualifies as a small quantity generator and is not a RCRA permitted facility.

Apparently there is a NPDES permit for the site that is associated with the old (now defunct) sanitary sewage treatment facility. This site is now plumbed into a municipal publicly owned treatment works (Collier Township Sanitation).

PADEP has repeatedly stated that their first concern is with defining the full extent of the groundwater contamination, whether that is onsite or offsite. They have suggested sampling of offsite groundwater seeps to help locate potential perched aquifers that may have been impacted beneath the site. However, the Army is reluctant to sample (and to date has not sampled) offsite.

The site is currently one of the "scheduled sites" listed in the Multi-Site Agreement (see http://www.dep.state.pa.us/dep/deputate/airwaste/wm/REMSERV/DOD_MSA/dod_msa.htm). The Multi-Site Agreement is a cooperative agreement between the PADEP, the United States Army, Navy, Air Force and Defense Logistics Agency, in coordination with the Department of Defense (DoD). This agreement addresses the assessment and remediation of selected sites in the Commonwealth by 2010. Under this agreement, Pennsylvania's Land Recycling and Environmental Remediation Standards Act (Act 2) approaches will be used, including cleanup standards, site assessment procedures, liability relief, and the options to use site specific, risk-based remediation criteria. The use of innovative technologies, state funding, work sharing, the creation of economic and job opportunities, as well as new ways to assure mutual accountability and long term planning are among the concepts addressed.

The Agreement includes an inventory of over 1000 military sites in Pennsylvania, which are listed as:

1. Scheduled sites (53 sites);
2. Deferred sites (364 sites); and
3. Study sites (659 sites).

The "Scheduled Sites" are those locations at which actual assessment and remediation is already planned under the Agreement. The Building S-15 site is one of the "scheduled sites".

3. ***Overview of Site Geology/Hydrology.***

Building S-15 is located in the Appalachian Plateau physiographic province of western Pennsylvania. Building S-15 lies at an elevation of ~1260 ft above mean sea level near the top of an eroded and dissected portion of the uplifted Appalachian Plateau.

Topographically, Building S-15 lies in a saddle near the top of a drainage divide between the Robinson Run watershed and the Thoms Run watershed (Figure 1). Building S-15 rests on well-consolidated sedimentary rocks overlain by a thin ($\leq$20 ft) mantle of silty clay. The Building S-15 site lies near the summit of a topographic high, 360 feet above the adjacent valley floor of Robinson Run.

Much of the surface beneath the area of Building S-15 is covered with asphalt over a gravel and/or slag substrate, which altogether may be up to 2.5 ft thick. Below this is a nearly continuous layer of mostly silty clay 8-15 feet thick (Figure 2). The silty clay has been described as moist, slightly plastic, and well sorted. Trace amounts and lenses of sand and/or gravel occur sporadically. The silty clay layer grades downward into bedrock of the Monongahela Formation and represents a residual soil formed as a result of in situ, surficial weathering of the underlying bedrock over time. Bedrock beneath the silty clay layer is mostly shale and/or siltstone; lesser amounts of sandstone and limestone are also present. A thin layer of sandstone directly underlies the silty clay layer beneath the UST removed from Building S-15 (Figure 2).

Beneath Building S-15 the Pennsylvanian Monongahela Formation is nearly flat-lying. Beds exposed in a roadcut 500 feet west-southwest of Building S-15, have an average strike of about N25E and dip gently (~4.5 degrees) to the southeast. The Monongahela Formation, along with the underlying Casselman Formation of the Conemaugh Group, comprise cyclic sequences of shale, limestone, sandstone and coal (Wagner et al. 1975), but are characterized by an abundance of freshwater carbonates (limestone and dolomite) and a relative lack of sandstone (Cate and Heyman 1974). Up to one-half of the total thickness of the Monongahela Formation is limestone, which is interbedded with shale, sandstone, and coal (Gallaher 1973). About 200 ft below Building S-15 lies a 60-foot-thick coal bed referred to as the Pittsburgh Coal Member, which forms the upper boundary of the Conemaugh Group (Figure 3). The Pittsburgh Coal is a prominent coal bed that has been extensively strip-mined in the area. It is uncertain at this time whether some of the coal may have been underground-mined from below Building S-15.

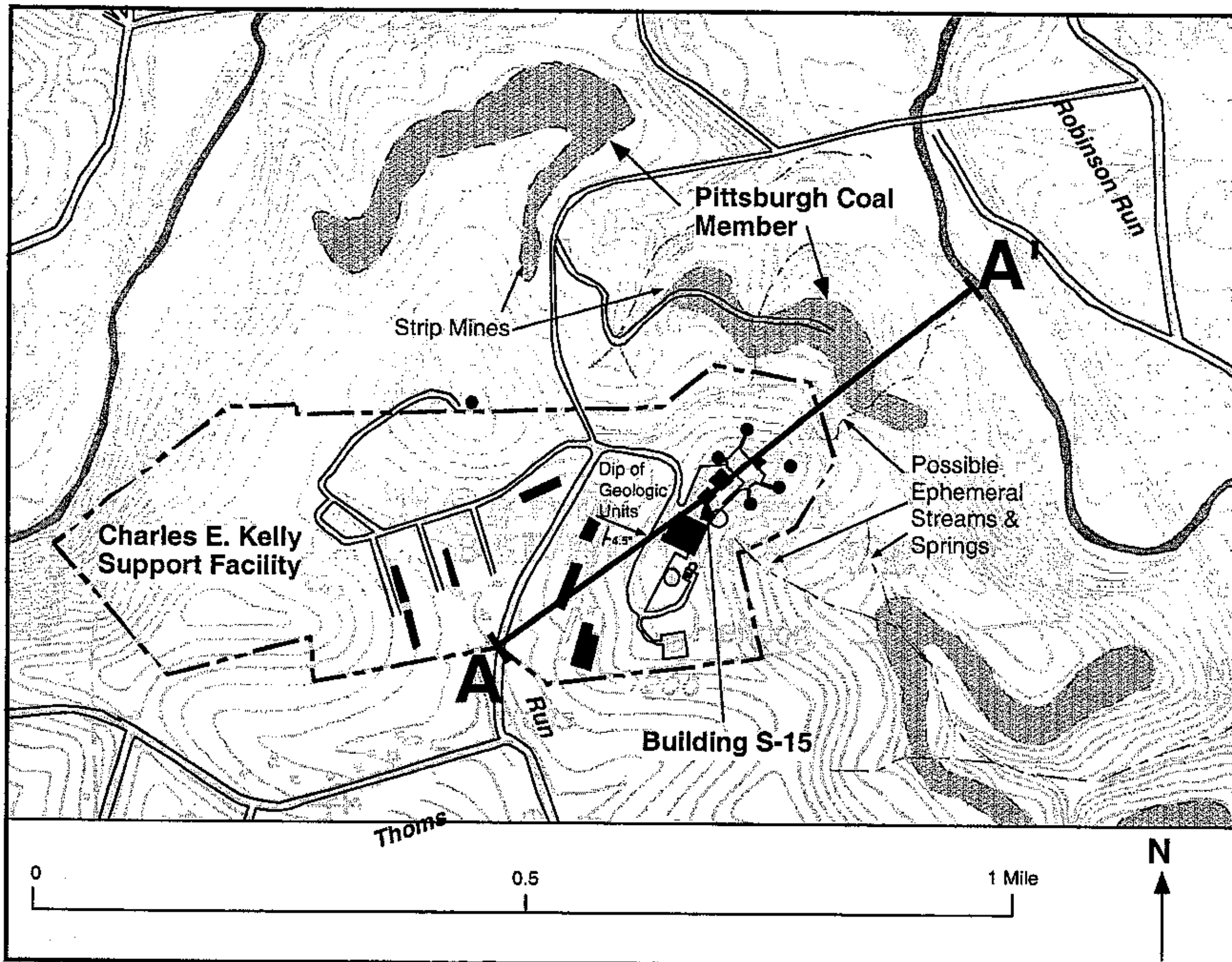

Figure 1. Geohydrologic Map of the Building S-15 Area. Cross section A-A' shown on Figure 3.

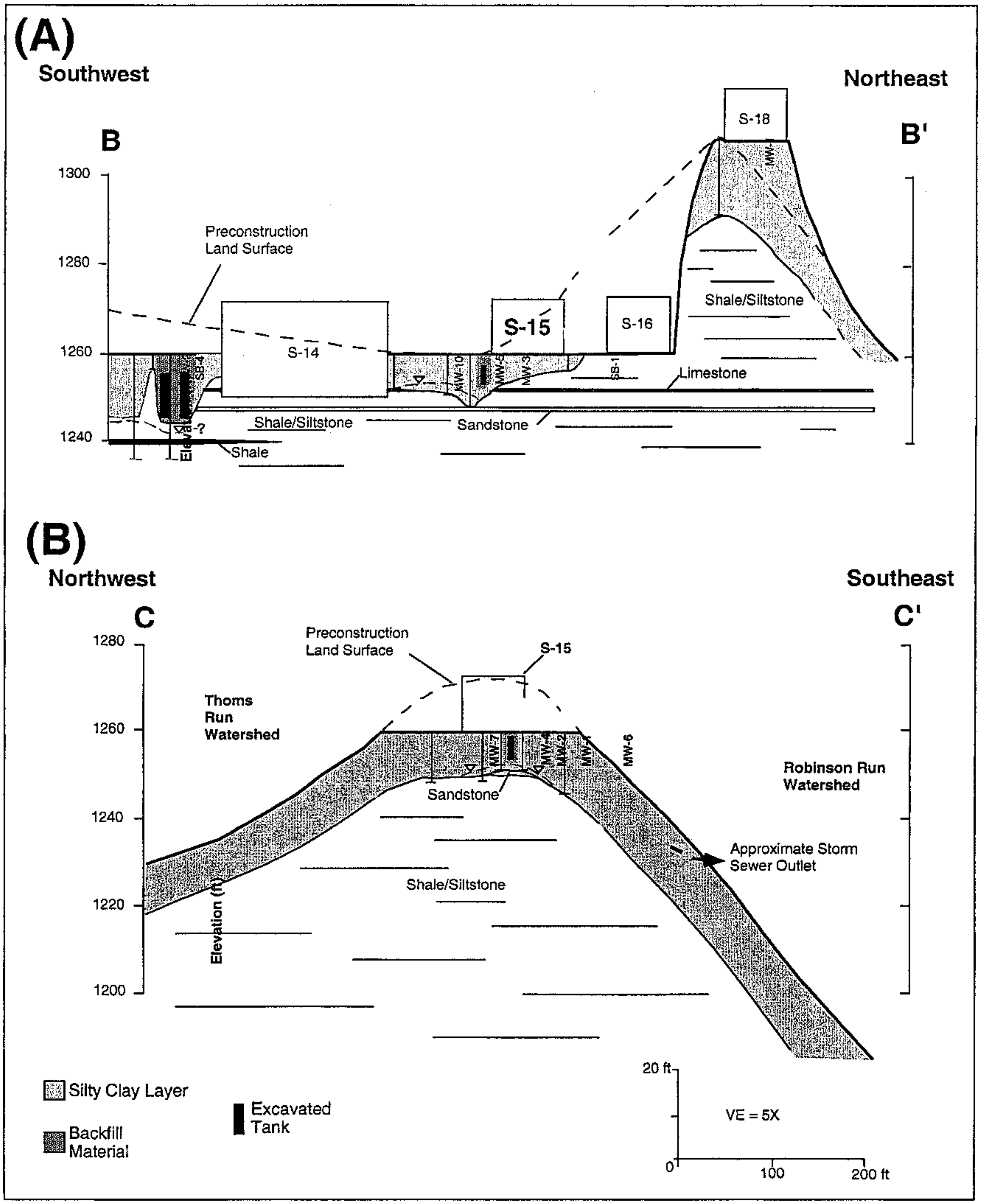

Figure 2. Geohydrologic Cross Sections Through the Building S-15 Site (See Figure 4 for the locations of these cross sections.

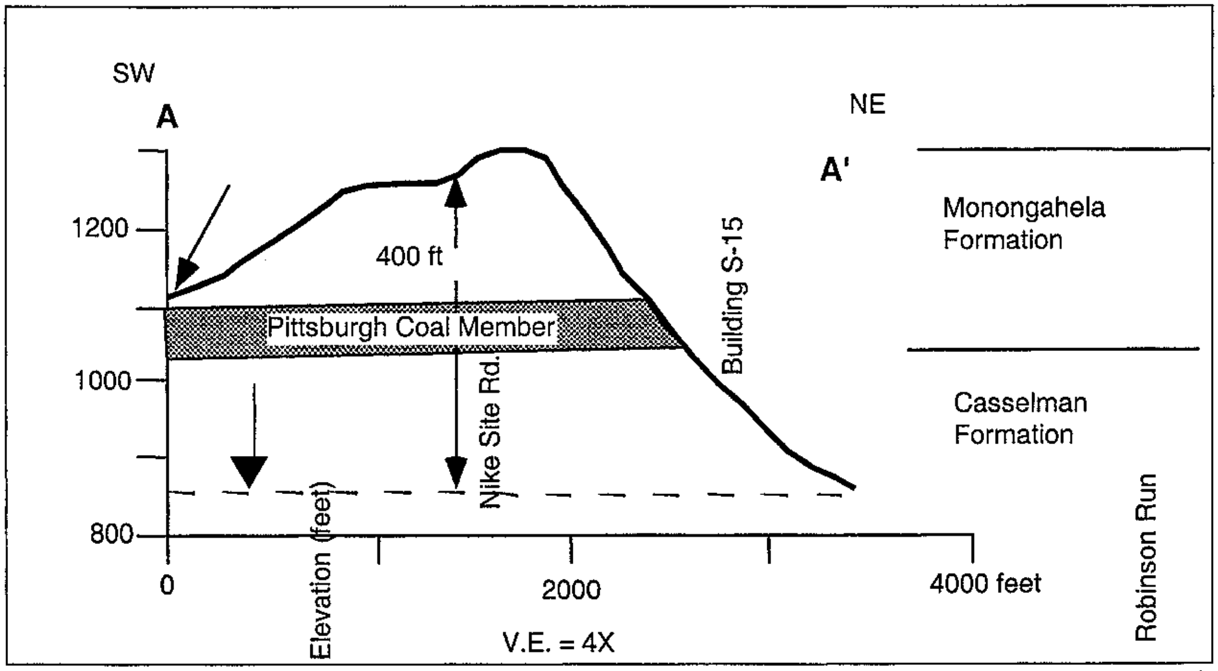

Figure 3. Generalized Geohydrologic Cross Section (see Figure 1 for location).

Because the Building S-15 site lies at the top of a ridge, surface water and groundwater move laterally away from the site, along steep gradients that occur on either side (Figure 4). The region receives large amounts of precipitation (average of 37 inches of precipitation annually) (Gallaher 1973).

There are a total of ten groundwater monitoring wells and one soil boring (SB-1) at Building S-15. Other nearby boreholes include four monitoring wells and 12 shallow borings at Building S-14, and three monitoring wells at Building S-18. Due to the low permeability and slow well-recharge rates, groundwater was generally not encountered in boreholes during drilling, with the exception of MW-8 at Building S-15. Since the wells were installed, depth-to-water measurements show that some of the wells (MW-6, -7, and –10) are frequently dry (Table 1).

Table 1. Recent water level data.

Monitor Well No.	2"PVC Inside	8/13/98		8/14/98		9/3/98		7/14/99		9/11/99	
		D/W (ft)	Elev. (ft)	D/W (ft)	Elev. (ft)	D/W (ft)	Elev. (ft)	D/W (ft)	Elev. (ft)	D/W (ft)	Elev. (ft)
MW1	1290.51	8.14	1282.37	NM	NA	8.19	1282.32	8.20	1282.31	8.51	1282.00
MW2	1290.60	7.77	1282.83	NM	NA	NM	NA	7.20	1283.40	7.58	1283.02
MW3	1290.33	7.86	1282.47	NM	NA	7.92	1282.41	8.20	1282.13	8.48	1281.86
MW4	1290.62	8.92	1281.70	NM	NA	8.50	1282.12	7.43	1283.19	7.95	1282.67
MW5	1290.00	NM	NA	6.72	1283.28	6.23	1283.77	6.17	1283.83	7.33	1282.68
MW6	1290.31	dry	NA	NM	NA	dry	NA	dry	NA	dry	NA
MW7	1290.62	dry	NA	NM	NA	dry	NA	dry	NA	dry	NA
MW8	1289.50	NM	NA	9.56	1279.94	8.52	1280.98	7.96	1281.54	9.01	1280.49
MW9	1290.44	14.45	1275.99	NM	NA	14.49	1275.95	14.45	1275.99	14.42	1276.03
MW10	1290.55	NM	NA	NM	NA	NM	NA	dry	NA	NM	NA

Limited groundwater occurs in the silty clay above bedrock (ES 1994b). Despite the relatively impermeable soil matrix there exists a near-surface aquifer, probably perched atop the shaly bedrock substrate that underlies most of the area in the vicinity of

Building S-15 (Figures 2 and 4). Based on a water level survey performed at Building S-15 in July 1995, a near-surface aquifer of limited areal extent is approximately centered over, and moves radially away from, well MW-5 (Figure 4). Other subsequent water-level surveys performed in August and September of 1998, and July 1999 (Table 1), corroborate the existence of this perched aquifer in the surficial silty clay layer. The mounded aquifer, with a hydraulic gradient up to 0.13 ft/ft or 7.4 degrees, does not appear to extend far laterally beyond the saddle (Figure 4).

The near-surface groundwater mound is coincident with a storm sewer drain that collects water running off the Building S-15 parking lot (Figure 4). It is possible that this storm sewer leaks leading to the development of the groundwater mound. The perched groundwater mound may also be topographically controlled, since it lies within a saddle, and therefore may be collecting groundwater from higher-elevation areas along the ridgeline (Figure 4). Another scenario for the source of the groundwater mound is from enhanced recharge associated with a roof drain that discharged water into an unpaved portion of the asphalt, where the 650-gallon UST used to be. This situation existed between tank removal (1994) and July, 1998, when the area over the excavated tank was paved. In 1997, it was discovered that many of the flush-mounted well housings were defective and leaking; these may also have resulted in recharge to the uppermost groundwater zone in the vicinity of Building S-15. The defective well housings have since been repaired (Schalla and Newcomer 1998).

Nearby, just south of Building S-14 (Figure 4), groundwater was found stratigraphically lower than at S-15, perched atop a shale bed within a shale-siltstone sequence (Figure 2). Similar perched zones within the bedrock beneath Building S-15 probably exist, but no wells have been drilled below the clay layer, into the bedrock, to confirm their presence. Similarly, no groundwater has been observed at the Building S-18 site (Figures 2 and 4), which only has wells in the surface silty clay layer and not in bedrock. The behavior of the perched aquifers is poorly understood at this time, but it is likely that multiple discontinuous perched aquifers exist above 850 ft, which is the elevation of the top of the regional water table in this area (Gallaher 1973). The top of the regional water table lies within the Casselman Formation, approximately 400 ft below Building S-15 (Figure 3).

In roadcuts multiple perched-water zones and lateral spreading are apparent along less permeable beds of the Monongahela and Casselman Formations in the vadose zone. Similar perched water zones likely exist in the bedrock beneath Building S-15. Some of the groundwater may travel vertically along fractures before moving laterally along less permeable (i.e., shale) beds. It is believed that the predominant flow direction in the uppermost perched aquifers is horizontal with discharge to the soil mantle along the hillslope. However, the possibility of some flow and contaminant transport downward to other perched aquifers has not been ruled out. Groundwater moving laterally above the 850-ft in elevation will eventually sap out onto the surface in the form of springs. Increased fracturing and dewatering of perched groundwater aquifers could occur beneath Building S-15 just above the Pittsburgh Coal bed (Figure 3) if any unsupported roof material in underlying worked-out coal mines exists (Gallaher 1973).

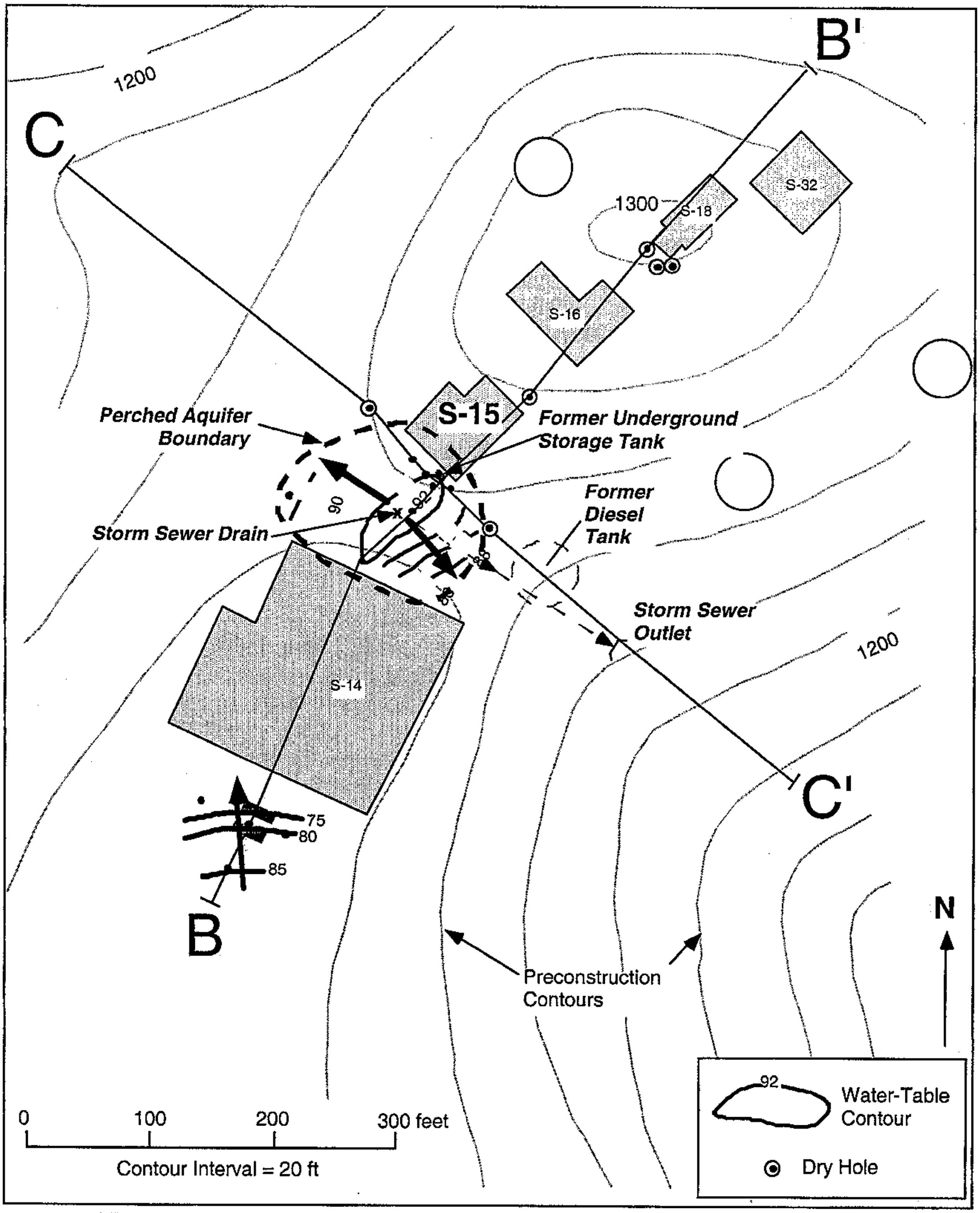

Figure 4. Potentiometric Surface of Uppermost Perched Aquifers

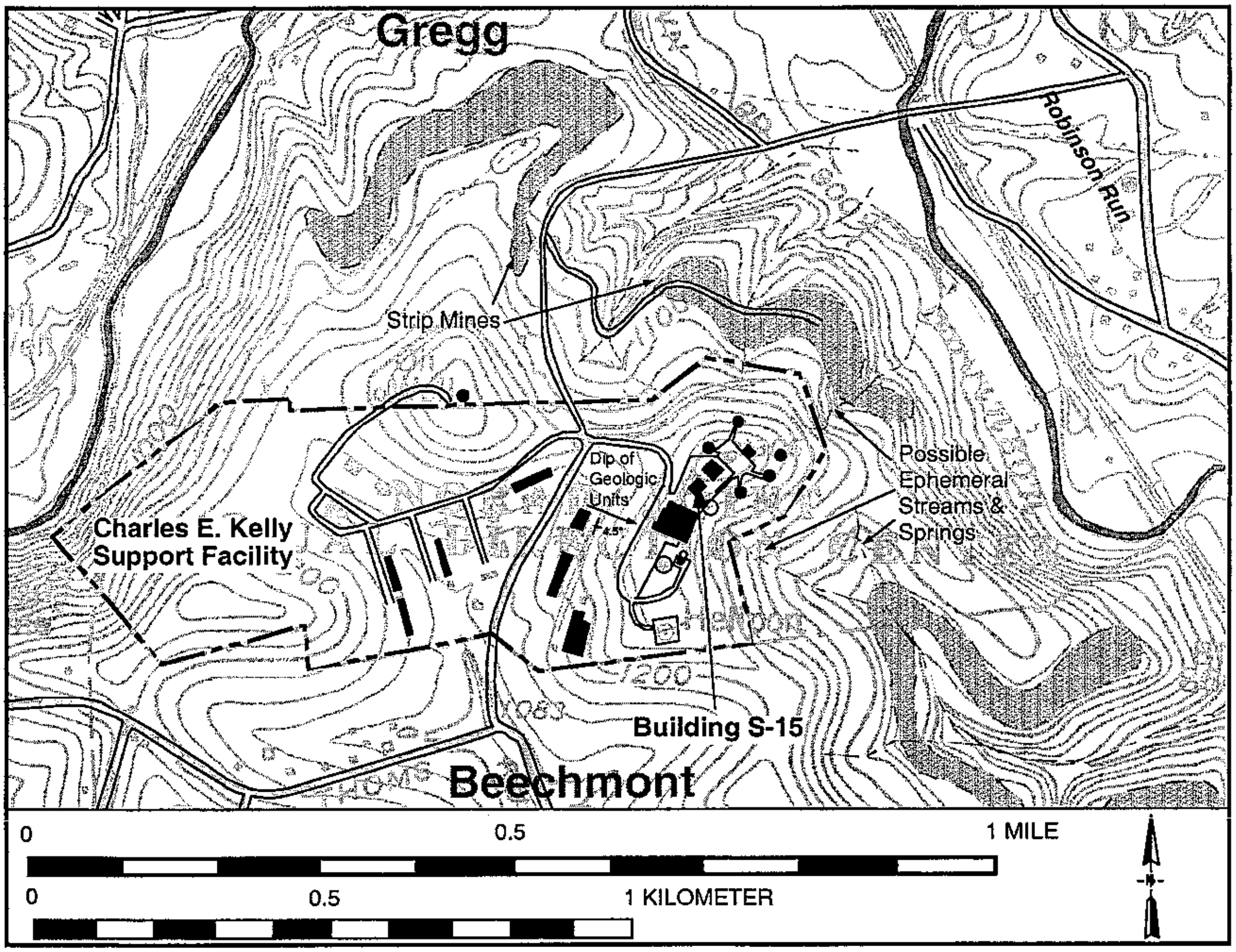

Figure 5. Location of nearby residents.

Groundwater flow in the vicinity of Building S-15 appears to be to the northwest and southeast, mimicking the topography and surface drainages. The site is surrounded by small rural communities, the closest of which are Gregg, Rennerdale, and Beechmont, all located within 0.5 miles of the site. Of these, the most likely impacted residents would be those in the vicinity of Rennerdale. Perhaps the shortest route to these receptors maybe via groundwater flow to seeps and then via ephemeral streams to Robinson Run.

The principal surface water body of concern is Robinson Run, which is fed by ephemeral seeps and streams, and perhaps feed by stormwater discharged from the site.

Table 2. Well Specifications.

Well Number	Coordinates [a]		Well Vault Lid Elevation [a]	Inner Casing (Riser) Elevation [a]	Drill Depth [b]	Inner Casing (Riser) dia. [b]	Casing Material [b]	Screen Length [b]	Screen Slot Size [b]	Depth of Screened Interval [b]		Sand Pack [b]	
	North	East								Top of Screen	Bottom of Screen	Top of Sandpack	Bottom of Sandpack
			(ft)	(ft)	(ft)	(in.)		(ft)	(in.)	(ft)	(ft)	(ft)	(ft)
MW-1	397,258.14	1,329,340.61	1290.98	1290.51	9	2	PVC	6	0.010	3.0	9.0	2.0	9.0
MW-2	397,273.76	1,329,323.03	1291.00	1290.60	9	2	PVC	6	0.010	3.0	9.0	2.0	9.0
MW-3	397,259.67	1,329,324.27	1290.85	1290.33	11	2	PVC	8	0.010	3.0	11.0	2.0	11.0
MW-4	397,285.85	1,329,310.54	1291.08	1290.62	11	2	PVC	8	0.010	3.0	11.0	2.0	11.0
MW-5	397,238.40	1,329,310.26	1290.47	1290.00	9	2	PVC	6	0.010	3.0	9.0	2.0	9.0
MW-6	397,224.55	1,329,376.32	1290.90	1290.31	13	2	PVC	10	0.010	3.0	13.0	2.0	13.0
MW-7	397,327.83	1,329,279.02	1291.08	1290.62	11	2	PVC	8	0.010	3.0	11.0	2.0	11.0
MW-8	397,255.08	1,329,207.21	1290.10	1289.50	14	2	PVC	10	0.010	4.0	14.0	3.0	14.0
MW-9	397,179.83	1,329,317.19	1290.80	1290.44	15.5	2	PVC	10	0.010	5.5	15.5	4.0	15.5
MW-10	397,199.67	1,329,263.28	1291.00	1290.55	8	2	PVC	5	0.010	3.0	8.0	2.0	8.0

[a] = from Alstate's Survey on 12/15/98.
[b] = from ESE, 1995
[c] = from Schalla and Newcomer, 1998

The contaminants of concern (i.e., those that exceed PADEP's statewide health standard) are benzene, TCE, vinyl chloride, PCE, 1,1-DCA, naphthalene, and bis(2-ethylhexyl)phthalate. Lead and manganese also exceed the statewide-health standards, but only in unfiltered samples, and are believed to be naturally occurring. In addition, a thin LNAPL layer has been occasionally observed in MW-2. Fingerprint analyses indicate that this LNAPL is diesel fuel.

Contaminant plumes for the most widespread of these contaminants are provided on the attached pages.

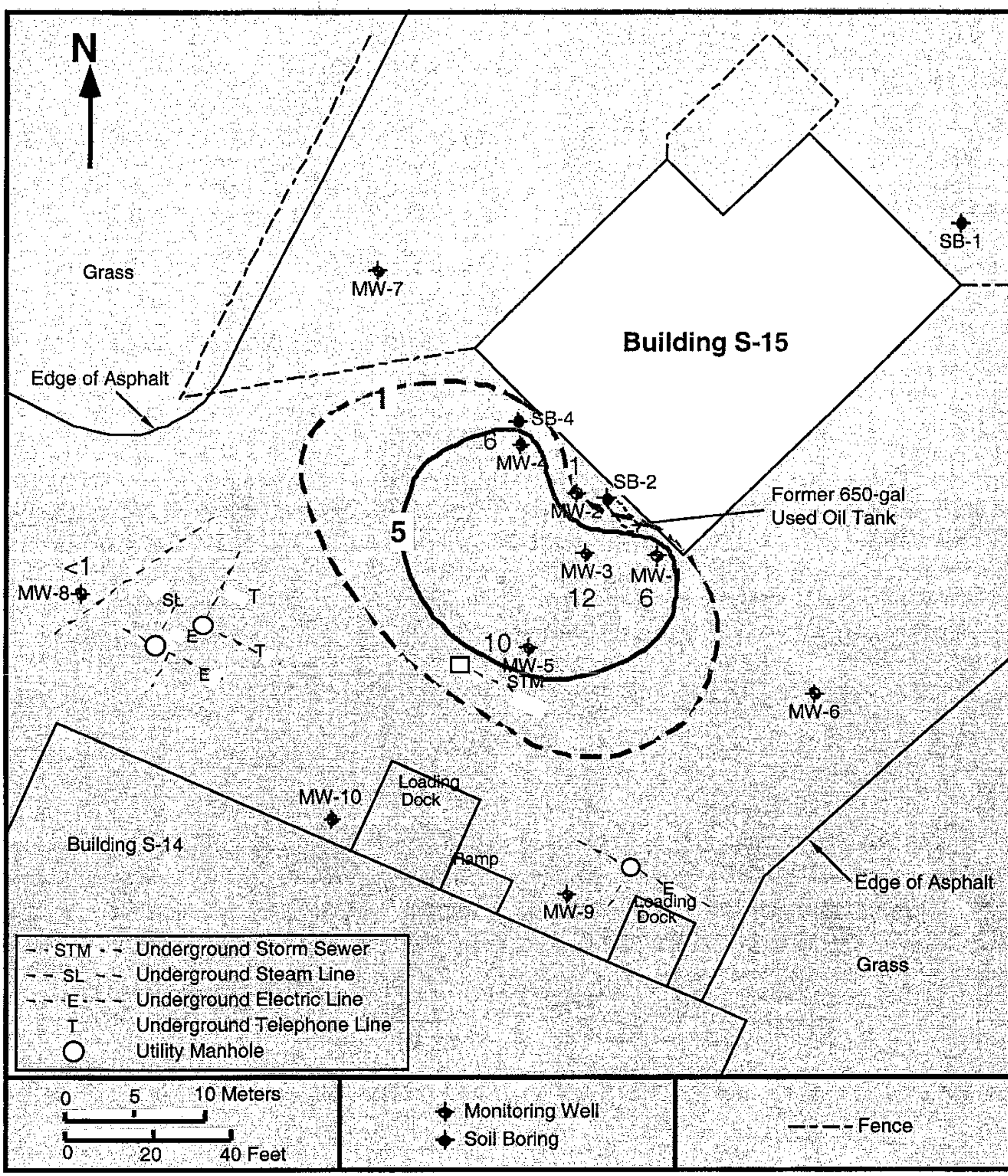

Figure 6. Concentration of Benzene in Groundwater (μg/L), October, 1998.

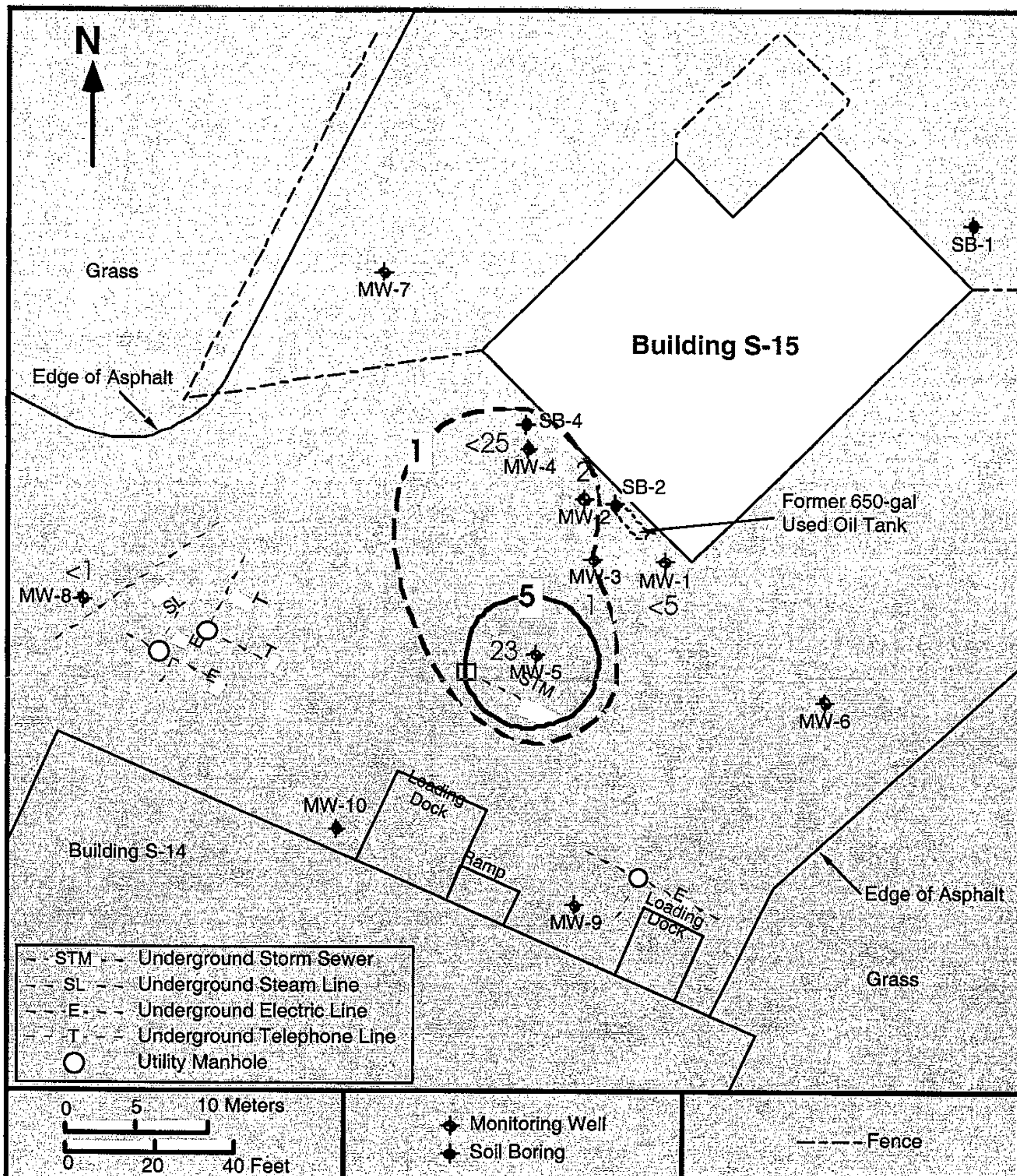

Figure 7. Concentration of TCE in Groundwater (μg/L), October 1998.

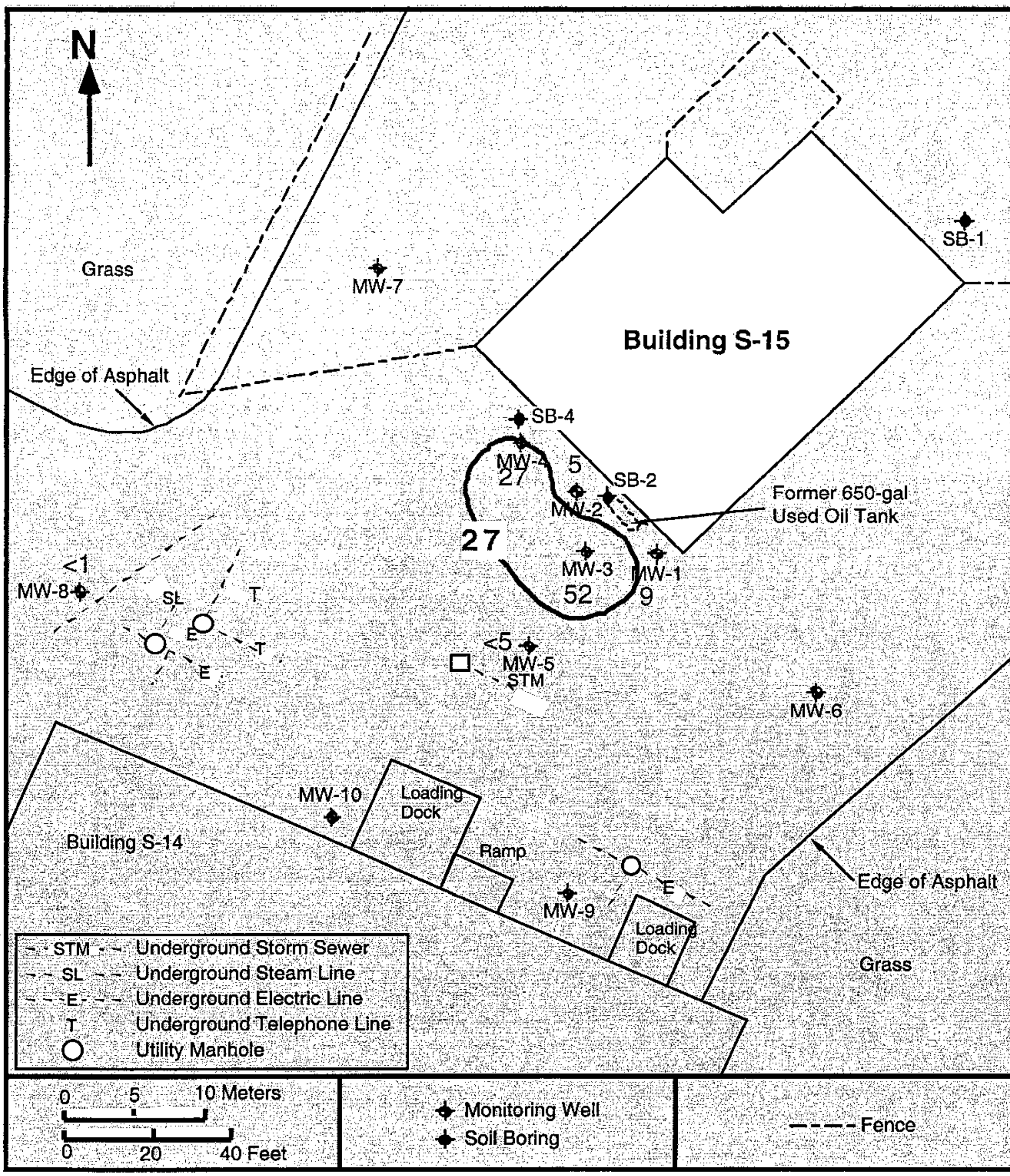

Figure 8. Concentration of 1,1-DCA in groundwater (μg/L), October, 1998.

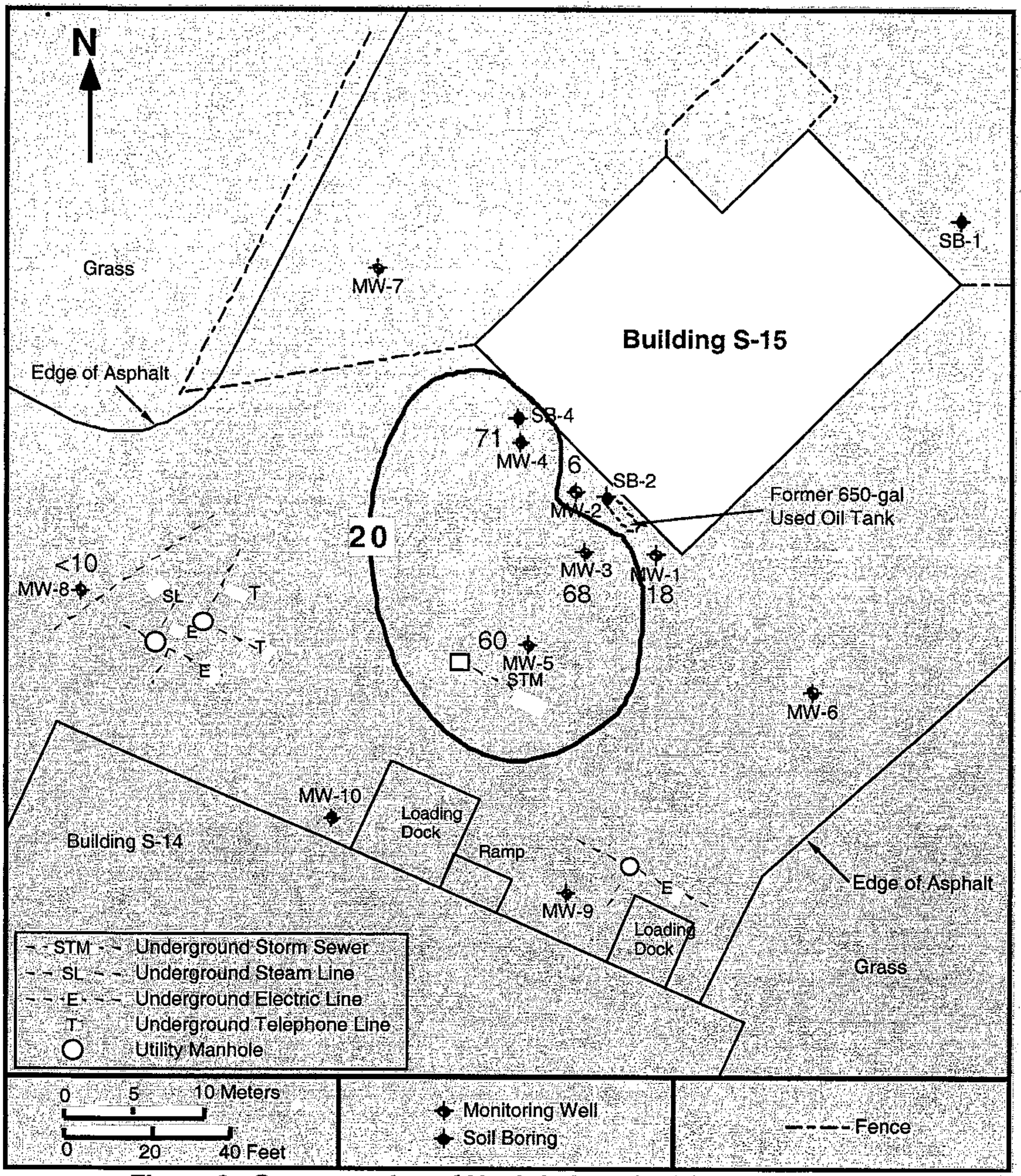

Figure 9. Concentration of Naphthalene (μg/L), October 1998.

See enclosed Excel spreadsheet for a summary of groundwater quality data.

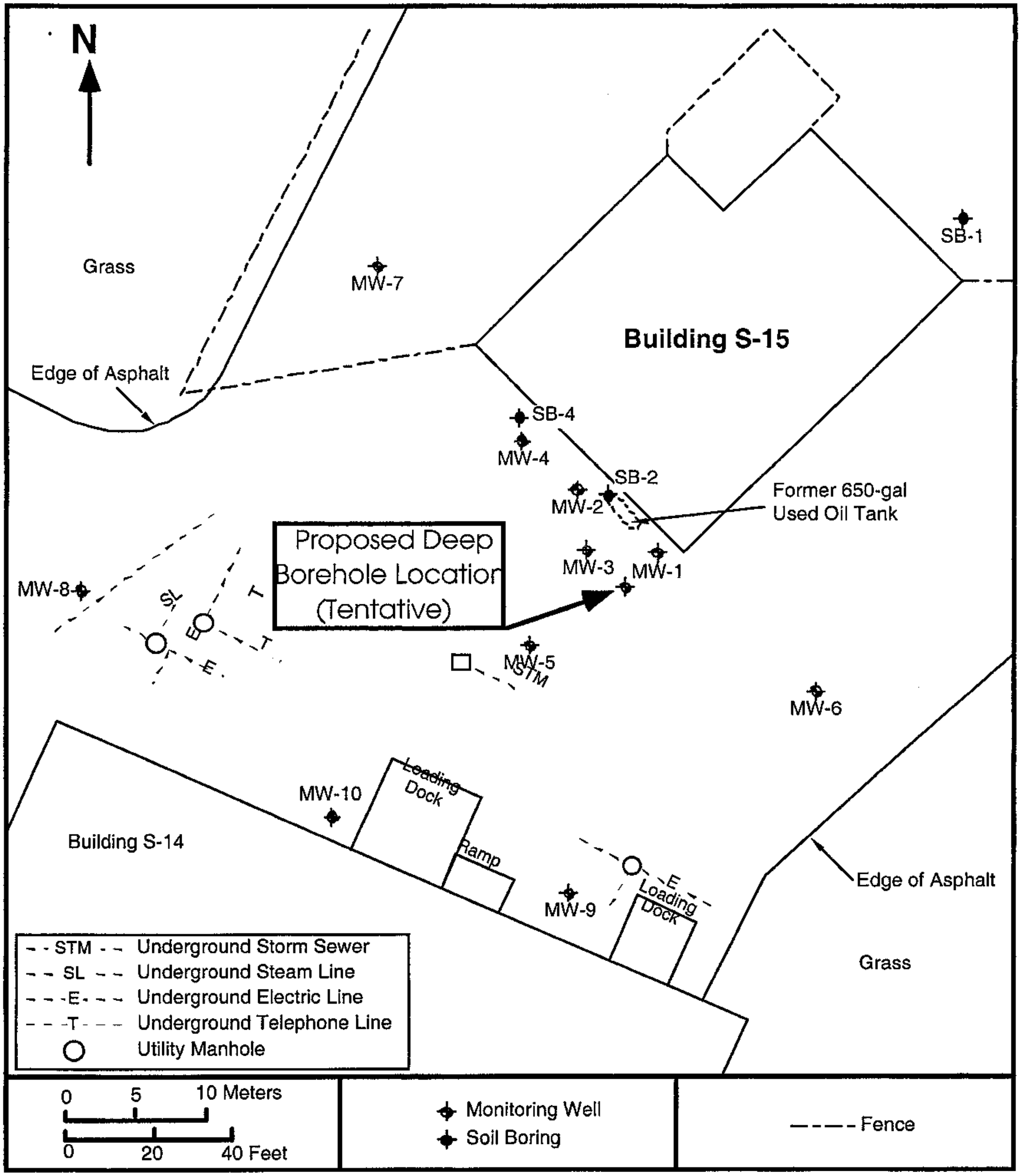

Figure 10. Proposed Deep Borehole Location.

4. Fate and Transport of Contaminants.

The used oil storage tank was removed from the site, however, contaminated soil was placed back in the tank excavation on top of a visqueen liner. The location was later backfilled and paved. The soil contamination on site is concentrated under a paved area southwest of Building S-15. The site is expected to remain industrial for the foreseeable future. Groundwater in the uppermost perched aquifer is contaminated with hydrocarbons and volatile organic compounds at levels greater than regulatory criteria for residential groundwater. The primary offsite exposure route of concern is through groundwater to either springs and seeps or to wells. Both ecological and human receptors are of concern.

The conceptual model for contaminant transport is through partitioning into the infiltrating precipitation (possibly leakage from storm drains) and groundwater from contaminated sediments and residual petroleum product (LNAPL). Some lateral flow along the top of the bedrock may occur, followed by flow through colluvium on the hill slopes to seeps. In addition there is the potential for vertical flow downward through fractures in the bedrock from the contaminated perched aquifer to lower perched aquifers which may flow off site. The number and depths of potential lower aquifers are unknown. The regional aquifer is located below the Pittsburgh coal member. It is considered unlikely that contamination would penetrate to the regional aquifer. The organic contaminants potentially would sorb to the Pittsburgh and other coal seams.

Additional data are needed to assess the presence and impacts of lower perched aquifers. A proposed well to be drilled at the site would be used to decide if lower perched aquifers are present and are contaminated. In addition, the presence of contamination in springs and seeps has not been assessed. If contamination is not detected in lower perched aquifers and is not detected in springs, then this will be considered evidence that significant impact from the site is unlikely. Hence it is extremely important that the proposed test well be drilled and completed very carefully so as to not drag or smear contamination along the section.